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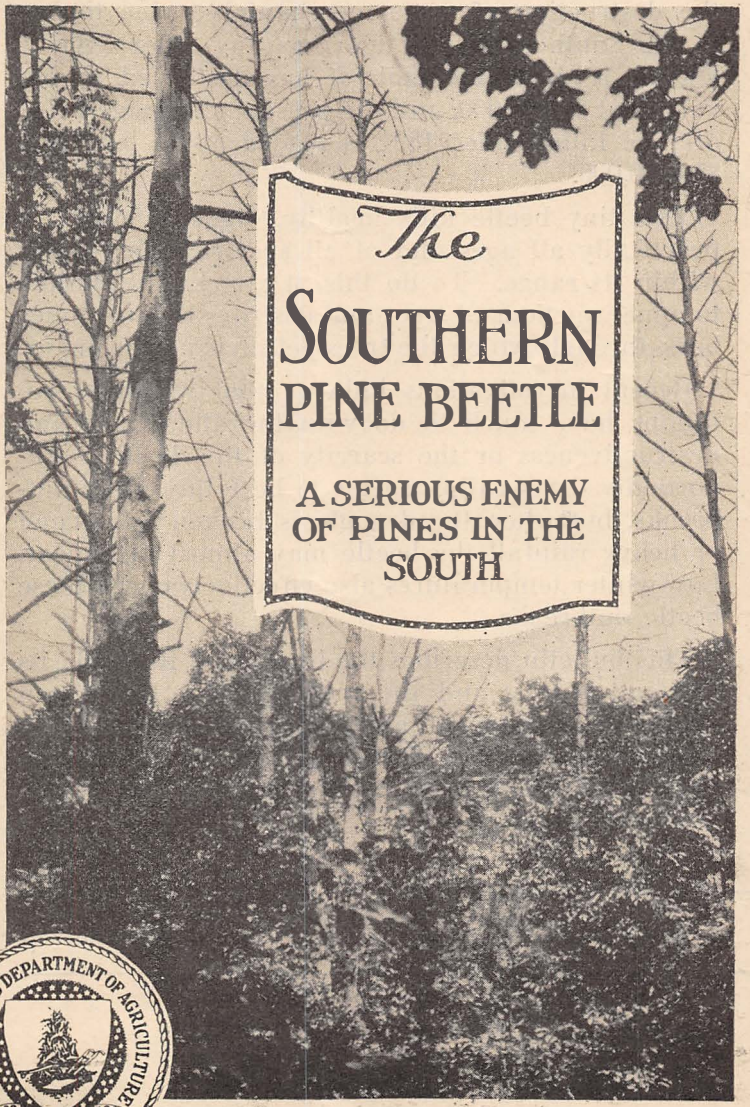

The SOUTHERN PINE BEETLE

A SERIOUS ENEMY OF PINES IN THE SOUTH

THE PERIODIC widespread devastations of the southern pine beetle have been responsible for the destruction of more merchantable pine timber in the Southern States than has any other agency. During a single epidemic it has destroyed timber valued at $2,000,000, and the present stumpage value of pine killed since 1891 is placed at no less than $50,000,000.

This tiny beetle kills healthy, vigorous pines of practically all ages and of all species which occur within its range. To do this, it attacks the middle to upper portions of trees and destroys the soft inner bark through which the trees get their nourishment.

Recent investigations indicate that weather conditions have much to do with the abundance and destructiveness or the scarcity of this beetle. Abnormally dry weather seems to be followed by outbreaks, but when the drought is broken by normal or heavy rainfall the beetle may almost disappear. Low winter temperatures also effectively check these beetle outbreaks.

This bulletin describes the insect and its work, its life and habits, and the methods that have been employed to prevent and suppress outbreaks. It supersedes Farmers' Bulletin 1188, The Southern Pine Beetle: A Menace to the Pine Timber of the Southern States.

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THE SOUTHERN PINE BEETLE: A SERIOUS ENEMY OF PINES IN THE SOUTH

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BEETLE OUTBREAKS AND THEIR IMPORTANCE

EVERY FEW YEARS patches of dying and dead pines may be seen throughout the southern forests. These group killings can usually be attributed to a bark beetle known as the southern pine beetle.[1] Ordinarily it is a rather rare insect, breeding in small numbers in weakened and dying trees. Periodically, however, favorable conditions occur for development of its broods, enabling it to increase in a very short time from a few individuals to countless hordes. Results of recent investigations of the Bureau of Entomology indicate that abnormally dry spells bring about favorable conditions for outbreaks, both by weakening the trees and by creating a more favorable situation in the inner bark for the rapid development of the broods of the beetle. The resumption of normal or heavy precipitation effectively checks such development and very nearly eliminates the beetle from the forest. Low winter temperatures also effectively check the increase of the beetle.

Other agencies which affect the trees, making it easier for the beetles to overcome their resistance, are fire, wind, and lightning. Trees weakened by these agencies, or by mechanical means, constitute a menace to the surrounding forest. Many infestations owe their origin to the attractiveness of a single weakened tree; therefore such a tree should be removed immediately. During periods when the beetles are present in small numbers, abnormal trees enable the bark beetles to establish themselves and breed up to normal numbers, whereupon they again can become destructive, killing groups of surrounding healthy trees. Results of recent studies suggest that trees

[1] *Dendroctonus frontalis* Zimm.; order Coleoptera, family Scolytidae.

on burned areas serve as an attraction to the beetles. This is an additional reason for adequate fire protection. "Blow downs" occurring during the summer, as well as the large quantities of timber normally cut at this time, also create conditions which are a menace to the surrounding healthy trees. This freshly cut or damaged timber is frequently attractive to the beetles.

There is probably no more serious enemy of pines in the Southern States than this beetle. It attacks and kills healthy, vigorous pines

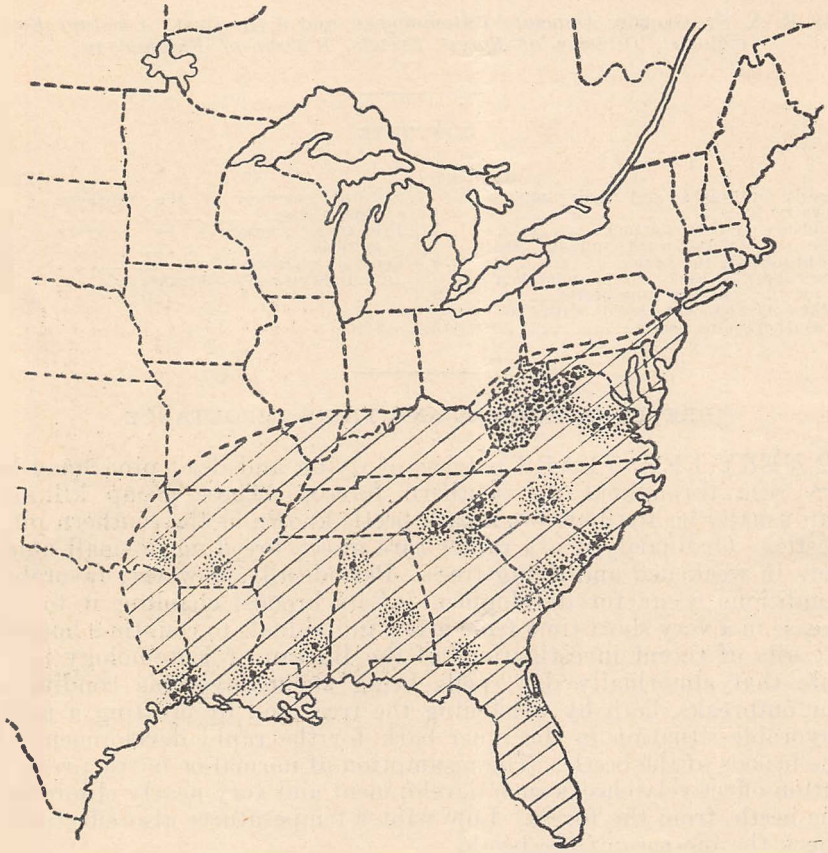

FIGURE 1.—Map showing distribution of the southern pine beetle. The dots represent known centers of infestation

of all species occurring within its range, including those of practically all ages. Extended observations in the Southern States since 1891 have led forest entomologists to place the present stumpage value of pine killed during this time at no less than $50,000,000. Hopkins [2] places the value of timber killed by this beetle, during a single epidemic in the South Atlantic and Gulf States in the years

[2] HOPKINS, A. D. THE SOUTHERN PINE BEETLE: A MENACE TO THE PINE TIMBER OF THE SOUTHERN STATES. U. S. Dept. Agr. Farmers' Bul. 1188, 15 p., illus. 1921.

1908 to 1911, inclusive, at $2,000,000. In 1922 and 1923 extensive outbreaks of this beetle were again reported or observed, and a vast quantity of timber was known to have been killed. The latest outbreaks took place in 1925, 1926, and 1927. It is well known that only a comparatively small percentage of the destroyed pine was ever salvaged after these epidemics. There is constant danger that the beetle status may again rise to the danger point.

No part of the South is free from this bark beetle. Its outbreaks occur periodically throughout the States of Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Tennessee, Kentucky, South Carolina, North Carolina, Virginia, West Virginia, Maryland, and Delaware. The beetle is also known to occur in the southernmost

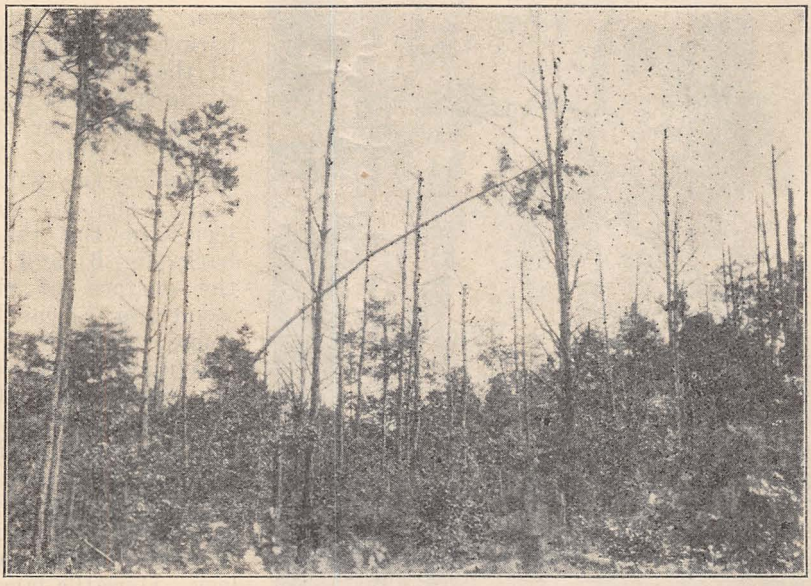

FIGURE 2.—A group killing by the southern pine beetle. Appearance of forest area several years after the trees were killed. Note the new growth

portions of New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Missouri, eastern Oklahoma, and northern Florida. Centers of infestation and distribution are shown in Figure 1.

EVIDENCE OF BEETLE ATTACK

Wherever patches of dying or dead pine are found (figs. 2 and 10) which show no evidence of fire or other destructive injury, there need be little doubt that they have been attacked by the southern pine beetle. These trees can be discovered most easily after they have been infested from 10 days to two weeks, when they display a yellowish-green foliage easily seen from long distances. The color gradually turns to a brownish green, and finally, about the time the beetles emerge, to a reddish brown. Pitch tubes often occur along the

middle and upper trunk (fig. 3), but they should not be confused with the larger tubes of the turpentine beetles [3] which are found near the ground. (Fig. 15.) Reddish sawdustlike borings can often be found sprinkled along the trunk and on the ground around the base of the tree. A blue-stain fungus which results in lowering the grade of salvaged lumber is always associated with trees killed by this beetle. (Fig. 4.) The stain quickly extends to the heartwood. (Fig. 5.)

FIGURE 3.—Pitch tubes made by the southern pine beetle along the middle trunk. About one-half natural size

Where any doubt exists as to the species attacking the trees, close examination of the inner bark from the middle of the trunk of the dying trees will positively determine the insect. Here the characteristic winding, S-shaped galleries in the inner bark (fig. 6) and on the surface of the wood (fig. 7) can be found, and by removing a portion of the outer bark the developing broods can be seen. The burrows of the grubs, or larvæ, extend only about half an inch from the parent gallery. Here the larvæ make oval cells in the outer bark and go into a resting stage—that is, become pupæ, before transforming into beetles.

THE BEETLE: ITS WORK AND ITS LIFE THROUGHOUT THE YEAR

Like most insects, the southern pine beetle passes through four distinct stages during its life history. These are the egg, the larva, the pupa, and the adult. The adult (fig. 8, at right) is a small brownish or blackish beetle about one-eighth inch long. It flies throughout the year except during the cooler winter months, when it remains dormant within its galleries beneath the bark. It usually attacks the

[3] The red turpentine beetle (*Dendroctonus valens* Lec.) and the black turpentine beetle (*D. terebrans* Oliv.)

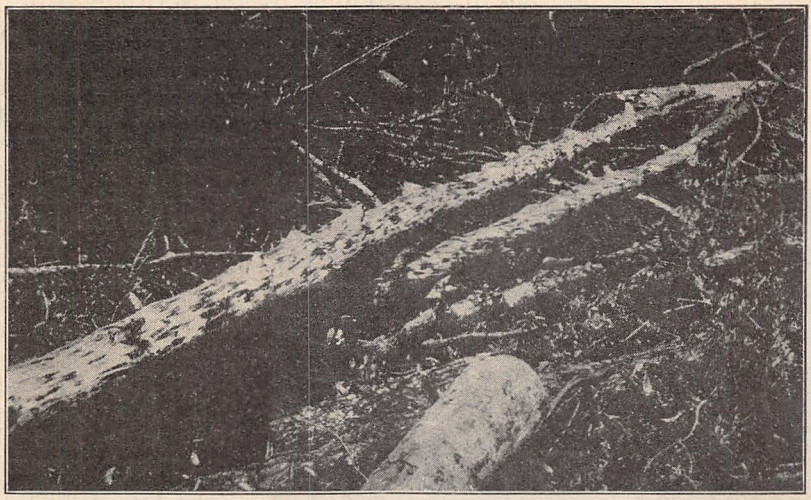

FIGURE 4.—Blue-stained, dead trees. The blue stain is alway associated with trees killed by the southern pine beetle

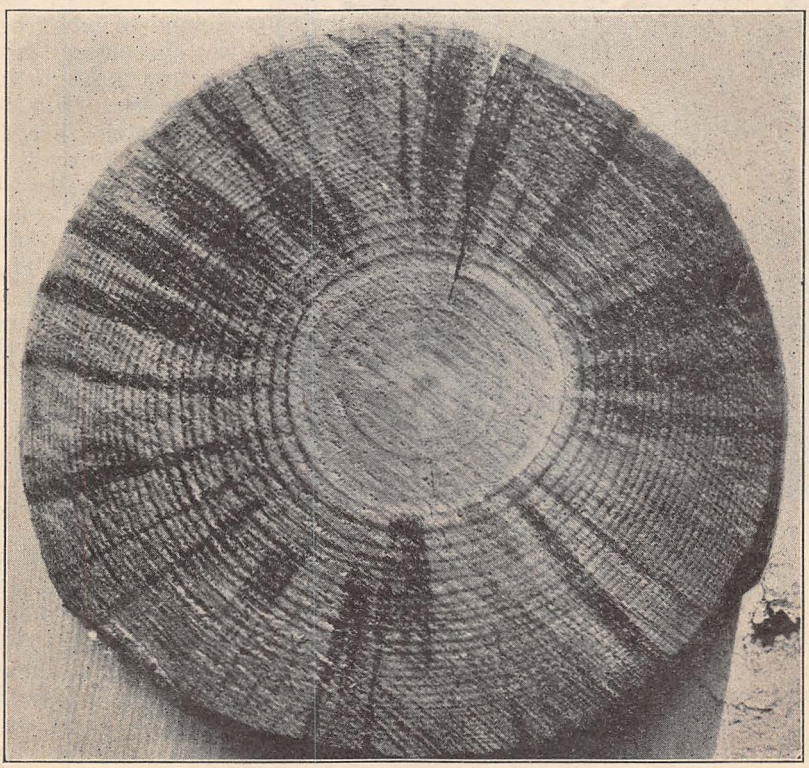

FIGURE 5.—Cross section of pine tree killed by the southern pine beetle, showing the associated blue stain extending to heartwood, causing a lowering in grade of merchantable timber

central and upper portions of healthy pine trees (see title-page illustration) as well as weakened trees and occasionally girdled trees and felled logs. Sometimes the attack on standing trees extends almost to the ground. The beetles bore in through the bark and excavate long, winding, S-shaped galleries (fig. 7) which extend through the inner layers of the living bark and mark the surface of the wood. They deposit their eggs in small niches along the sides of the galleries. From these eggs young grubs, or larvæ (fig. 8, at left), hatch and feed on the inner bark (fig. 6) until full grown, when they mine into the outer bark, excavate cells, and transform to the pupal or resting stage. In from 7 to 10 days they change to adult beetles and emerge from the tree through tiny exit holes. (Fig. 9.) The beetles then fly to other living trees or occasionally to suitable logs, where they lay eggs to start the next brood. They pass the winter in all stages of development, between the bark and the wood or in the bark itself. The trees that harbor them may be living, dying, or even dead. The more advanced beetles begin to emerge and fly in the spring about the time the redbud [4] blooms, and the later ones continue to develop and emerge until midsummer when the blackberries begin to ripen. Trees attacked during the previous fall are dead and abandoned by the beetles before the following July. (Fig. 10.) Those attacked during the early part of the summer are dead and abandoned by midsummer of the same year.

FIGURE 6.—S-shaped galleries made by adults of the southern pine beetle in the inner, soft bark of pine. Note the oval larval or grub cells about one-fourth to one-half inch on each side of the egg tunnels. Slightly reduced

[4] *Cercis canadensis* L.

FIGURE 7.—S-shaped adult-beetle galleries marking the surface of the wood. The larger ones are those of the southern pine sawyer, which often destroys many of the broods of the southern pine beetle. Slightly reduced

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From three to five generations occur annually, the number of generations depending on the section of the country in which the beetle occurs, the length of the summer season, the climatic conditions, and the vigor of the beetles. Flight begins in the spring and early summer. The first generation begins with the eggs of the overwintered beetles. When the larvæ from these eggs have developed into adult beetles the first generation is complete. The second generation begins with the eggs laid by the newly formed beetles, and so the process continues until checked by cold weather.

Under favorable conditions a brood can develop from egg to adult in from 30 to 40 days, and the number of beetles can increase as much as 1,000 per cent in a single generation. With the possibility of producing five generations a year, the beetles' capacity for increase and for starting sudden outbreaks is very great.

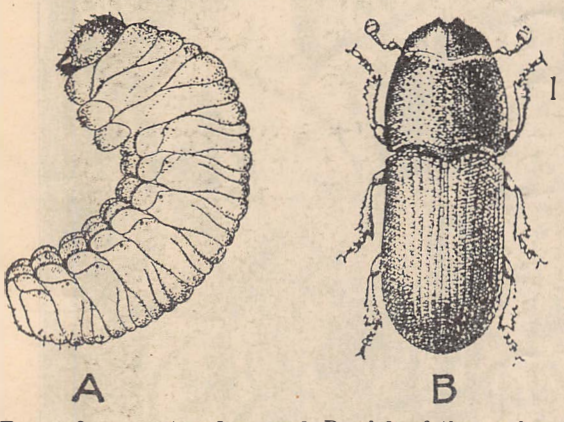

FIGURE 8.—A, mature larva and, B, adult of the southern pine beetle. Greatly enlarged. (The vertical line indicates the natural size of the beetle.) (Hopkins)

BARK BEETLES LIKELY TO BE MISTAKEN FOR THE SOUTHERN PINE BEETLE

A great many other bark beetles are often associated with the southern pine beetle, but in this bulletin only those most likely to be confused with our most serious enemy of southern pines will be mentioned, namely, the turpentine beetles and the Ips bark beetles.

The Ips bark beetles can be distinguished from the southern pine beetle by the form of the body and the type of tunnel they make. The chief difference between them is seen in the form of the posterior end of the abdomen. In the southern pine beetle this is gradually rounded out in a convex manner (fig. 11, A), whereas in the Ips bark beetles it is scooped out and armed on both sides of this depression with minute toothlike projections. (Fig. 11, C and D.) The egg galleries of Ips are straight or star shaped (figs. 12 and 13), whereas those of the southern pine beetle have a characteristic serpentine, S-shaped appearance. (Figs. 6 and 7.) Furthermore, the grubs of the southern pine beetle bore for a distance of about one-half inch from the parent tunnel and mature in the outer bark, whereas most of the species of the Ips grubs work from 2 to 3 inches from the adult gallery and mature between the inner bark and wood. One very small species of Ips [5] works near the top of the tree and makes a larval mine about one-half inch long like that of the southern pine beetle, but this work can be readily distinguished because the adult gallery is comparatively straight and not S-shaped. (Fig. 14.)

[5] *Ips avulsus* Eich.

FIGURE 9.—Exit holes made by new southern pine beetles emerging from the bark. About two-thirds natural size

FIGURE 10.—Trees abandoned by the southern pine beetle soon after being killed

This difference in habits is made use of in control of beetle outbreaks. The southern pine beetle attacks and kills healthy, vigorous green pines of practically all species and sizes within its range, Shortleaf pine[6] is probably its most favored host, while longleaf pine[7] is least favored and rarely attacked. The only trees not attacked by it are the smaller pines below 2 inches in diameter (breast height) and less than 20 years old. The Ips beetles attack dying trees, recently killed trees, and trees weakened by some other agency. Although insects of this latter group may hasten the death of some trees, they seldom are the cause of it except under unnatural conditions. Trees seriously affected by drought, fire, girdling, or primary insects may be successfully attacked by Ips.

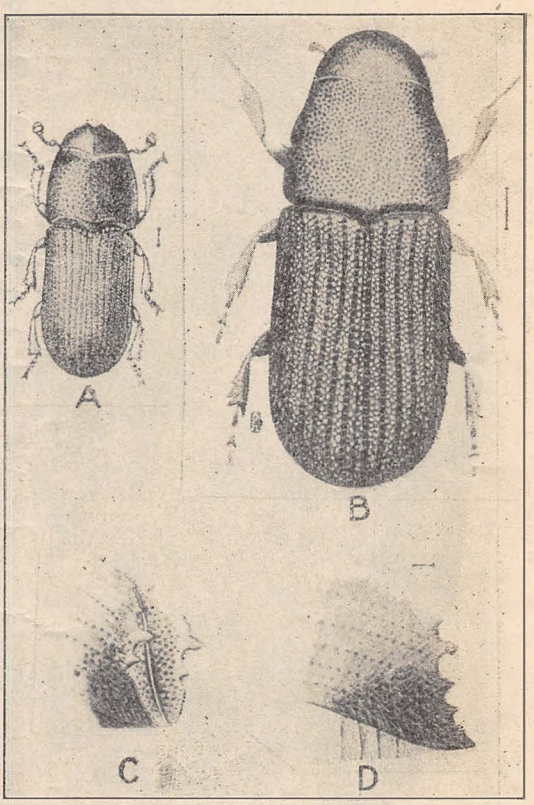

FIGURE 11.—Adult bark beetles: A, The southern pine beetle (note end of abdomen gradually rounded out in a convex manner); B, one of the turpentine beetles similar in shape to A but larger; C and D, parts of Ips bark beetles showing posterior end of abdomen scooped out and armed with toothlike projections. The short lines indicate the natural lengths of the beetles. (B, C, and D after Swain)

The turpentine beetles (fig. 11, B) are similar in form to the southern pine beetle but are about twice as large, being about one-fourth inch in length. They often attack the bases of pines surrounding newly constructed buildings or camps, or anywhere where the cutting or wounding of pines has taken place. They are rarely able to complete their life cycle in green trees and are usually drowned out by the flow of pitch. Normally they breed in stumps and felled logs and are not capable of killing trees. Occasionally, however, they attack weakened, dying, and girdled trees and develop healthy broods in them. In girdled trees they attack below the girdle, where growth has ceased. Trunks of standing trees are seldom attacked by this beetle at points more than 6 feet from the ground. Their work is readily detected, because there are large pitch tubes near the base of attacked trees (fig. 15), and when the bark is removed their long galleries, about a half inch wide and filled with pitch and borings, are exposed. The grubs, working

[6] *Pinus echinata* Mill. [7] *Pinus palustris* Mill.

FIGURE 12.—Ips bark beetle gallery in center with long radiating larval tunnels, more or less at right angles to the adult egg tunnel. About two-thirds natural size

together, often completely excavate the soft inner bark around a portion of the base of the tree, thereby causing the outer bark to loosen and fall off. Hopkins [8] has pointed out that this large area, where the wood has been exposed, is often mistaken for a fire scar. These beetles should cause little alarm, as they seldom, if ever, kill the trees.

OTHER BEETLES ASSOCIATED WITH THE SOUTHERN PINE BEETLE

A beetle [9] commonly associated with trees attacked by the southern pine beetle is one of the long-horned beetles, the larvæ of which are known as round-headed borers or, locally, more commonly called sawyers or fish bait. The adult is an elongated beetle about 1 inch in length, of a mottled-gray color. (Fig. 16.) The male has long feelers or horns (antennæ), which are often two or three times as long as the body. The larvæ may be recognized as elongated, footless grubs of a grayish-white color, which vary in size according to the age of the individuals. When fully mature they are about 2 inches long. (Fig. 16, *i*.) Although this beetle is in no way responsible for the death of trees, it quickly reduces the value of the logs for salvage purposes, since it reduces the lumber from the best grades to No. 1 common. The injury is caused by the grubs, which often destroy some of the broods of the destructive pine beetle while working under the bark, but later ruin the sapwood of the logs if it is not salvaged during midsummer within two weeks after the trees begin to die.

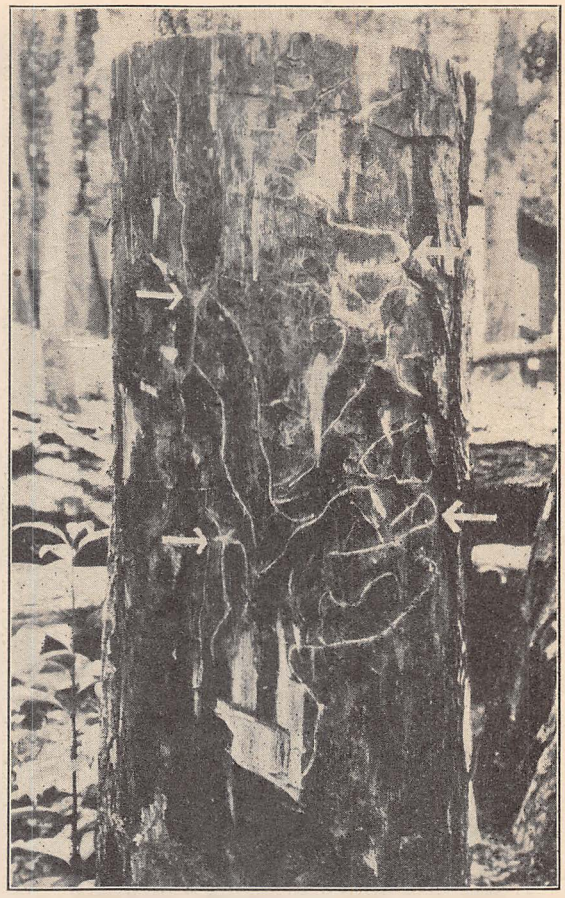

FIGURE 13.—Types of galleries of the southern pine beetle and the associated Ips bark beetles in a 10-inch log. Note the star-shaped and straight galleries of Ips bark beetles on left and the serpentine S-shaped galleries of the southern pine beetle on right, as indicated by arrows

[8] HOPKINS, A. D. CONTRIBUTIONS TOWARD A MONOGRAPH OF THE SCOLYTID BEETLES. I. THE GENUS DENDROCTONUS. U. S. Dept. Agr., Bur. Ent. Tech. Ser. 17 (1) : 153. 1909.

[9] *Monochamus titillator* Fab.

FIGURE 14.—Work of *Ips avulsus* in bark removed from upper part of tree. Note the comparatively straight adult gallery. About natural size

Other grubs, similar in form to the sawyer grubs and often mistaken for them, attack pines already infested by the southern pine beetle, or some other destructive agency, but these are not serious enemies of the southern pine and therefore are not discussed here. Many other bark beetles, most of them smaller species, work in dying and dead pine, but these are not likely to be confused with our most serious enemy of southern pines and therefore need not be mentioned further.

FIGURE 15.—Tubes of the black turpentine beetle within 5 feet of ground. Note that they are much larger than those of the southern pine beetle (fig. 3) usually found farther up the tree. About one-half natural size

NATURAL ENEMIES OF THE SOUTHERN PINE BEETLE

Birds and parasites are agencies which help to preserve the balance of nature. Woodpeckers, especially, have been repeatedly observed destroying the broods of this beetle. (Fig. 17.) Unfortunately these agencies are not present in our forests in large enough numbers to prevent or suppress outbreaks.

PREVENTIVE MEASURES BY FORESTRY METHODS

Outbreaks of the southern pine beetle usually occur in pure, even-aged pine stands, in which the trees are often attacked when only 20 years old. They rarely occur, however,

among pines growing in mixed hardwood stands. General observations throughout the Piedmont region indicate that pure pine stands eventually are transformed to a mixed pine-hardwood composition, because the hardwoods come in in the openings where the pines have been killed by this bark beetle. Wherever possible, the better hardwoods should be encouraged throughout the pure stands of pine so that a mixed type of forest may be developed which will not only be immune to further bark-beetle outbreaks but which also will produce a better grade of softwood lumber. Summer cutting of pines should be avoided whenever possible. Fires in pine areas increase the danger from pine-beetle attack and also destroy the hardwoods within the area, thus tending to create pure pine stands which are always subject to attack.

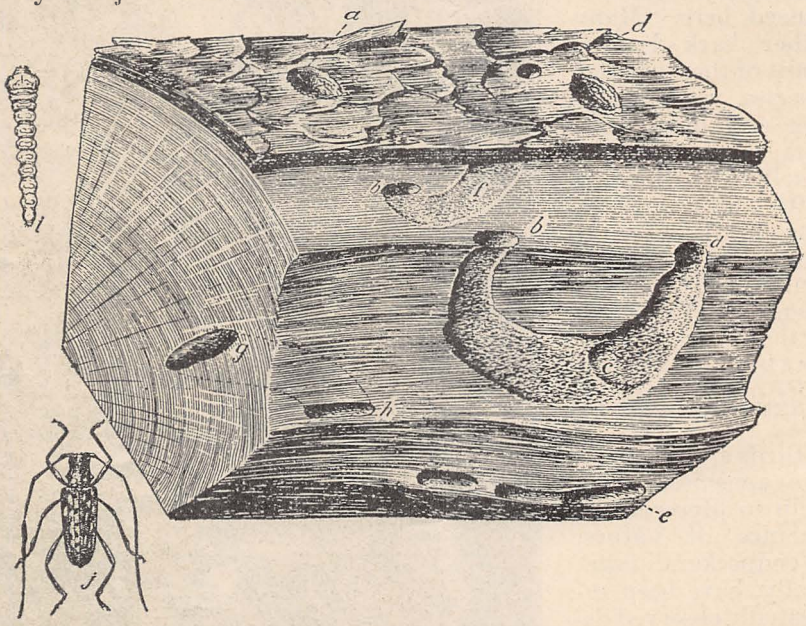

FIGURE 16.—Work of the southern pine sawyer. Section of trunk showing: *a*, Egg pit in bark; *b*, entrance hole of larva into wood; *c*, pupal cell; *d*, emergence hole; *e*, *g*, *h*, sections of larval mines; *f*, scored surface of wood, scoring done by larva preparatory to entering wood; *i*, larva; *j*, adult. Insect one-half natural size. (Webb)

During years of drought pine areas should be carefuly watched for the first evidence of the destructive southern pine beetle, so that measures may be taken to prevent any outbreaks from assuming epidemic proportions.

Since we know that single weakened trees serve as centers of attraction to the southern pine beetle, it is advisable to remove all such trees in order that they may not attract the beetles.

CONTROL MEASURES

Owing to the influence of weather conditions on the southern pine beetle, direct methods of control are recommended with considerable hesitation. It is evident that these beetles increase from a status of rarity to that of destructive abundance in a remarkably short time. On

the other hand, if heavy rains come they disappear quickly and the effort and money spent in control are wasted. It seems reasonable, however, to believe that if the situation were taken in hand at the outset and the insects thoroughly and persistently destroyed, it would be impossible for them to increase as rapidly as if nothing had been done, and considerable timber would thus be saved.

In control work, cooperation between the owners is necessary. It will do little good to clean up one area if timber in areas close to it serves as a source of infestation.

In such control the main objective is to destroy the broods developing in the bark of the tree, thus preventing them from emerging as beetles and destroying other living trees. This can be accomplished by one or another of the following methods:

(1) Felling and logging infested trees and removing the logs to a sawmill, the logs being immediately sawed and the slabs burned. This method is especially recommended where practical, since it permits salvage of the lumber which otherwise would be rapidly destroyed by borers and timber beetles.

FIGURE 17.—Tree attacked by the southern pine beetle. Note holes made by woodpeckers, indicating the high mortality of the brood. Portion of bark removed to show beetle galleries. About three-eighths natural size.

(2) Felling and limbing infested trees in a north-and-south direction and, after they have lain in this position a few days, turning them completely over. This measure is effective only in a well exposed sunny situation during midsummer. The insects under the bark on the exposed side of the log are all killed after about three days of hot sun. The logs are turned so that the

broods under the bark on the opposite side will be exposed to the sun and killed.

(3) Felling and barking infested trees and burning the bark and tops. This method is dangerous in the summer unless extreme precaution be taken to avoid fire. It is, however, a practical control measure in winter.

Whatever the method, it is essential that all the trees containing the living insects be treated. Some of these will still have green foliage or foliage that is only slightly faded, in which case boring dust or pitch tubes on the bark should be looked for as evidence of attack. When the foliage has turned brown, except where it has turned color late in the fall, the insects have already abandoned the trees.

All portions of the main stem up to a minimum of 4 inches in diameter should be treated. The limbs should either be scattered about so that they will be exposed to the sun and quickly dry out, or else they should be burned.

Do not treat trees, except for the purpose of salvage, if the bark shows innumerable small holes such as might be produced by a load of fine shot. The beetles have left the bark of such trees.

Prompt action is necessary. The sooner and the more effectively and persistently the work is carried out, the better will be the results.

Adequate fire protection will do much to reduce the ravages of the beetles, since they are attracted to scorched trees.

INVESTIGATIONS OF OUTBREAKS

The periodic widespread devastations of the southern pine beetle have been responsible for the destruction of more merchantable pine timber in the Southern States than has any other agency. For this reason, extensive investigations have been conducted from time to time to devise measures of control. The most recent facts contributing to a knowledge of the habits of this beetle have been gained as a result of projects carried on at a field station established during 1925, in cooperation with the Forest Service, in the Bent Creek section of the Pisgah National Forest, near Asheville, N. C. Insect studies pertinent to the forest districts of the Piedmont and coastal plains sections of the Southern Atlantic and Gulf States are now being conducted.[10]

[10] Information relating to forest-insect work can be obtained by addressing either the Division of Forest Insects of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., or the Forest Entomological Laboratory, Appalachian Experiment Station, Asheville, N. C.

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